

emphasis on quality is leading manufacturers to invest in automated inspection equipment and to take a more systematic approach to quality inspection. Continued improvements in technologies, such as spectrophotometers and computer-assisted visual inspection systems, allow firms to effectively automate simple inspection tasks, increasing worker productivity and reducing the demand for inspectors. As the price of these technologies continues to decrease, they will become more cost-effective for firms and will be more widely implemented in a broad range of industries.

Apart from automation, firms are improving quality by building it into the production process. This has led firms to redistribute many inspection duties from inspectors, testers, and graders to other production workers who monitor quality at every stage of the process. In addition, the growing implementation of statistical process control is resulting in "smarter" inspection. Using this system, firms survey the sources and incidence of defects so these firms can better focus their efforts and reduce production of defective products.

In many industries, however, automation is not being aggressively pursued as an alternative to manual inspection. When key inspection elements are oriented to size, such as length, width, or thickness, automation may play some role in the future. But when taste, smell, texture, appearance, or product performance are important, inspection will probably continue to be done by humans. Employment of inspectors, testers,

and graders is expected to increase in fast-growing industries, such as wholesale trade, and in business services as more manufacturers and industrial firms hire temporary inspectors to increase the flexibility of their staffing strategies.

Earnings

Median hourly earnings of inspectors, testers, and graders were \$11.28 in 1998. The middle 50 percent earned between \$8.63 and \$15.53 an hour. The lowest 10 percent earned less than \$6.78 an hour; the highest 10 percent earned more than \$20.40 an hour. Median hourly earnings of transportation inspectors in the railroad industry were \$18.10 in 1997.

Related Occupations

Workers who inspect products or services include construction and building inspectors, who examine a variety of structures, and inspectors and compliance officers, who inspect and enforce rules on matters such as health, safety, food, licensing, or finance.

Sources of Additional Information

For general information about inspectors, testers, and graders, contact:

- ✦ The National Tooling and Machining Association, 9300 Livingston Rd., Fort Washington, MD 20744. Internet: <http://www.ntma.org>
- ✦ The American Society for Quality, 611 East Wisconsin Ave., P.O. Box 3005, Milwaukee, WI 53201-3005. Internet: <http://www.asq.org>

Metalworking and Plastics-Working Occupations

Jewelers and Precious Stone and Metal Workers

(O*NET 89123A, 89123B, 89126C, 89126E, 89126K, and 89926A)

Significant Points

- About one-third of all jewelers were self-employed; many operated their own store or repair shop, and some specialized in designing and creating custom jewelry.
- Slightly over half of all salaried jewelers worked in retail establishments, while one-third were employed in manufacturing plants.
- Although employment is expected to decline slightly, prospects should be excellent as more people retire or leave the occupation.

Nature of the Work

Jewelers design, manufacture, repair, and adjust rings, necklaces, bracelets, earrings, and other jewelry. They use a variety of common and specialized handtools to mold and shape metal and set gemstones. Increasingly, jewelers use computers to design jewelry and lasers to perform very delicate and intricate work.

Jewelers usually specialize in one or more areas: Designing and manufacturing new pieces of jewelry, gem cutting, setting and polishing stones, or repairing broken items. Jewelers who are knowledgeable about the quality, characteristics, and value of gemstones also sell jewelry and provide appraisal services. In small retail or repair shops, jewelers may be involved in all aspects of the work. Jewelers who own or manage stores or shops also hire and train employees; order, market, and sell merchandise; and perform other managerial duties.

The work of jewelers requires a high degree of skill, precision, and attention to detail regardless of the type of establishment or work setting. Typical repair work includes enlarging or reducing ring sizes,

resetting stones, and replacing broken clasps and mountings. Some jewelers also design or make their own jewelry. Following their own designs, or those created by designers or customers, they begin by shaping the metal or carving wax to make a model for casting the metal. The individual parts are then soldered together, and the jeweler may mount a diamond or other gem, or engrave a design into the metal. Although jewelers mainly use computers for inventory control, some jewelry designers also use them to design and create customized pieces according to their customers' wishes. With the aid of computers, customers visualize different combinations of styles, cuts, shanks, sizes, and stones to create their own pieces.

In manufacturing, jewelers usually specialize in a single operation. Some may make models or tools for the jewelry that is to be produced. Others do finishing work, such as setting stones, polishing, or engraving. A growing number of jewelers use lasers for cutting and improving the quality of stones, intricate engraving or design work, and ID inscription. Some manufacturing firms use CAD/CAM (computer-aided design and manufacturing) to facilitate product design and automate some steps in the mold and model-making process. As such systems become more affordable, their use should increase. In larger manufacturing establishments, jewelers may be required to perform several tasks as new manufacturing processes make their way through the industry.

Working Conditions

A jeweler's work involves a great deal of concentration and attention to detail. Working on precious stones and metals, while trying to satisfy customers' and employers' demands for speed and quality, can cause fatigue or stress. However, the use of more ergonomically correct jewelers' benches has eliminated the strain and discomfort formerly caused by spending long periods bending over a workbench in one position. In larger manufacturing plants and some smaller repair shops, chemicals, sharp or pointed tools, and jewelers' torches pose potential safety threats and may cause injury if proper care is not taken.

In repair shops, jewelers usually work alone with little supervision. In retail stores, on the other hand, they may talk with customers about repairs, perform custom design work, and even do some sales work.



Jewelers and precious stone and metal workers use a variety of handtools to mold metal and set gemstones.

Because many of their materials are very valuable, jewelers must observe strict security procedures. These include locked doors that are only opened by a buzzer, barred windows, burglar alarms, and, for large jewelry establishments, the presence of armed guards.

Employment

Jewelers and precious stone and metal workers held about 30,000 jobs in 1998. About one-third of all these workers were self-employed; many operated their own store or repair shop, and some specialized in designing and creating custom jewelry.

One-half of all salaried jewelers worked in retail establishments, while one-third were employed in manufacturing plants. Although jewelry stores and repair shops can be found in every city and many small towns, most job opportunities are in larger metropolitan areas. Many jewelers employed in manufacturing work in Rhode Island, New York, and Los Angeles.

Training, Other Qualifications, and Advancement

Jewelers' skills usually are learned in vocational or technical schools, through correspondence courses, or informally on the job. Colleges and art and design schools also offer programs that can lead to a bachelor's or master's degree of fine arts in jewelry design. Formal training in the basic skills of the trade enhances one's employment and advancement opportunities. Many employers prefer jewelers with design, repair, and sales skills. Some aspiring jewelers begin working as clerks in department stores, and transfer to jobs in jewelry shops or manufacturing firms after gaining experience.

For those interested in working in a jewelry store or repair shop, vocational and technical schools or courses offered by local colleges are the best sources of training. In these programs, which vary in length from 6 months to 1 year, students learn the use and care of jewelers' tools and machines and basic jewelry making and repairing skills, such as design, casting, stone setting, and polishing. Technical school courses also cover topics including blueprint reading, math, and shop theory. To enter most technical school or college programs, a high school diploma or its equivalent is required. Because computer-aided design is used increasingly in the jewelry field, it is recommended that students—especially those interested in design and manufacturing—obtain training in CAD.

The Gemological Institute of America (GIA) offers programs lasting about 6 months and self-paced correspondence courses that may last longer. The GIA offers the graduate gemologist (G.G.) and graduate jeweler (G.J.) diplomas, along with a variety of courses in gemology and jewelry manufacturing and design. Advanced programs cover a wide range of topics, including the identification and grading of diamonds and gemstones.

Most employers feel that vocational and technical school graduates need several more years of supervised, on-the-job training to refine their repair skills and learn more about the operation of the store or shop. In addition, some employers encourage workers to improve their skills by enrolling in short-term technical school courses such as sample making, wax carving, or gemology. Many employers pay all or part of the cost of this additional training.

In jewelry manufacturing plants, workers traditionally develop their skills through informal apprenticeships and on-the-job training. This training lasts 3 to 4 years, depending on the difficulty of the specialty. Training usually focuses on casting, stonesetting, modelmaking, or engraving. In recent years, a growing number of technical schools and colleges have begun to offer training designed for jewelers working in manufacturing. Like employers in retail trade, though, those in manufacturing now prefer graduates of these programs because they are familiar with the production process, requiring less on-the-job training.

The precise and delicate nature of jewelry work requires finger and hand dexterity, good hand-eye coordination, patience, and concentration. Artistic ability and fashion consciousness are major assets because jewelry must be stylish and attractive. Those who work in jewelry stores have frequent contact with customers and should be neat, personable, and knowledgeable about the merchandise. In addition, employers require someone of good character because jewelers work with very valuable materials.

Advancement opportunities are limited and greatly dependent on an individual's skill and initiative. In manufacturing, some jewelers advance to supervisory jobs, such as master jeweler or head jeweler, but for most, advancement takes the form of higher pay doing the same job. Jewelers who work in jewelry stores or repair shops may become managers; some open their own businesses.

For those interested in starting their own business, they first should establish themselves and build a reputation for their work within the jewelry trade. Then, they can obtain sufficient credit from jewelry suppliers and wholesalers to acquire the necessary inventory. Also, because the jewelry business is highly competitive, jewelers who plan to open their own store should have experience in selling, as well as knowledge of marketing and business management. Courses in these areas often are available from technical schools and community colleges.

Job Outlook

Employment of jewelers and precious stone and metal workers is expected to decline through 2008. Employment opportunities, however, should be excellent, reflecting current shortages in the occupation and the need to replace jewelers who retire or leave the labor force for other reasons.

The demand for jewelry largely depends on the amount of disposable income people have. Therefore, the increasing number of affluent individuals, working women, double-income households, and fashion conscious men are expected to keep jewelry sales strong. Traditionally, job opportunities for jewelers depended largely on jewelry sales and demand for jewelry repair services, which makes up approximately half of a retail jewelry store's revenues. Now, however, non-traditional jewelry marketers, such as discount stores, mail-order catalogue companies, and television shopping networks have limited the growth of sales from traditional jewelers. These types of establishments require fewer jewelers, thus limiting job opportunities. Demand for jewelers who specialize in repair work, however, should remain steady or even increase as jewelry sales increase because non-traditional vendors typically do not offer repair services.

Opportunities in jewelry stores and repair shops will be best for graduates from a jeweler or gemologist training program. Demand for repair workers will be strong because maintaining and repairing jewelry is an ongoing process, even during economic slowdowns. In fact, demand for jewelry repair may increase during recessions as people repair or restore existing pieces rather than purchase new ones.

Within manufacturing, increasing automation will adversely affect employment of low-skilled occupations, such as assembler and polisher. Automation will have a lesser impact on more creative, highly

skilled positions, such as mold and model maker. Furthermore, small manufacturers, which typify the industry, will have an increasingly difficult time competing with the larger manufacturers when it comes to supplying large retailers. Because of recent international trade agreements, exports are increasing modestly as manufacturers become more competitive in foreign markets. However, imports from foreign manufacturers are increasing more rapidly than exports due to these same agreements.

Earnings

Median annual earnings for jewelers and precious stone and metal workers were \$23,820 in 1998. The middle 50 percent earned between \$17,110 and \$32,540. The lowest 10 percent earned less than \$12,670 and the highest 10 percent earned over \$41,160.

According to the Manufacturing Jewelers and Suppliers of America, the median average hourly wage of jewelers in companies with more than 10 employees was \$13.62 in 1998. Beginners in jewelry factories usually start at considerably less pay than experienced workers do. As they become more proficient, they receive raises.

Most jewelers enjoy a variety of benefits including reimbursement from their employers for work-related courses and discounts on jewelry purchases.

Related Occupations

Jewelers and precious stone and metal workers do precision handwork. Other skilled workers who do similar jobs include polishers, dental laboratory technicians, hand engravers, and watch makers and repairers.

Sources of Additional Information

Information on job opportunities and training programs for jewelers is available from:

✦ Gemological Institute of America, 5345 Armada Dr., Carlsbad, CA 92008.

✦ California Institute of Jewelry Training, 5800 Winding Way, Carmichael, CA 95608.

General career information is available from:

✦ Jewelers of America, 1185 Avenue of the Americas, 30th Floor, New York, NY 10036.

✦ Manufacturing Jewelers and Suppliers of America, 45 Royal Little Drive, Providence, RI 02904.

To receive a list of technical schools accredited by the Accrediting Commission of Career Schools and Colleges of Technology which have programs in jewelry design, contact:

✦ Accrediting Commission of Career Schools and Colleges of Technology, 2101 Wilson Blvd., Suite 302, Arlington, VA 22201.

Machinists and Numerical Control Machine Tool Programmers

(O*NET 25111 and 89108)

Significant Points

- Formal training in high schools, vocational schools, or community colleges is typical; many entrants have previously worked as machine tool operators or setters.
- Job opportunities will be excellent, as employers continue to report difficulties in finding workers with the necessary skills and knowledge.

Nature of the Work

Machinists use machine tools, such as lathes, drill presses, and milling machines to produce precision metal parts. Although they may produce large quantities of one part, precision machinists often produce small

batches or one-of-a-kind items. They use their knowledge of the working properties of metals and their skill with machine tools to plan and carry out the operations needed to make machined products that meet precise specifications.

Before they machine a part, machinists must carefully plan and prepare the operation. These workers first review blueprints or written specifications for a job. Next, they calculate where to cut or bore into the workpiece, how fast to feed the metal into the machine, and how much metal to remove. They then select tools and materials for the job, plan the sequence of cutting and finishing operations, and mark the metal stock to show where cuts should be made.

After this layout work is completed, machinists perform the necessary machining operations. They position the metal stock on the machine tool—drill presses, lathes, milling machines, or others—set the controls, and make the cuts. During the machining process, they must constantly monitor the feed and speed of the machine. Machinists also ensure that the workpiece is being properly lubricated and cooled, because the machining of metal products generates a significant amount of heat.

Some machinists, often called production machinists, may produce large quantities of one part, especially parts requiring complex operations and great precision. For unusually sophisticated procedures, expensive machinery is used. Usually, however, large numbers of parts requiring more routine operations are produced by metalworking and plastics-working machine operators. (See the statement on metalworking and plastics-working machine operators elsewhere in the *Handbook*.) Other machinists do maintenance work—repairing or making new parts for existing machinery. To



It takes several years to become a highly skilled machinist.